

CLAIMS

What is claimed is:

1. An analytic chemistry system, comprising a population of beads including separate subpopulations, each subpopulation carrying chemical functionality which changes an optical signature of the beads in the presence of targeted analytes, beads in each subpopulation having an optical signature which is encoded with a description of the chemical functionality carried by that subpopulation
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  2. The system described in Claim 1, wherein the beads are encoded using dyes.
  3. The system described in Claim 2, wherein the dyes are entrapped within the beads and the chemical functionality is on surfaces of the beads.
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  4. The system described in Claim 1, wherein the beads are encoded using fluorescent dyes.
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  6. The system described in Claim 1, wherein the chemical functionality changes the optical signature by producing an optically active chemical in the presence of targeted analytes.
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  7. The system described in Claim 1, wherein the optical signature is changed by the chemical functionalities of the beads by the presence or absence of a fluorescent signal.
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8. The system described in Claim 1, wherein the chemical functionalities of the beads support sites for hybridization.
9. The system described in Claim 1, wherein the beads are affixed to a distal end of an optical fiber bundle.
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10. The system described in Claim 1, wherein the beads are located within etched wells at terminal ends of optical fibers of the bundle.
11. A chemical analysis method, comprising  
10 preparing separate subpopulations of beads,  
each subpopulation carrying chemical  
functionalities that change optical signatures of  
the beads in the presence of targeted analytes;  
15 encoding optical signature of the beads in  
each subpopulation with a description of the  
chemical functionalities carried by that  
subpopulation;  
20 combining the subpopulations to produce a  
system;  
applying the system;  
detecting changes in the optical signatures  
indicative of a presence of the targeted  
analytes, and  
25 decoding optical signature of the beads to  
identify the chemical functionalities.
12. The method described in Claim 11, wherein encoding the optical signatures with the chemical functionalities comprises doping the beads with fluorescent dyes.
13. The method described in Claim 11, wherein encoding the  
30 optical signatures with chemical functionalities
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comprises attaching encoding dyes to the beads.

14. The method described in Claim 11, wherein encoding the optical signatures with the chemical functionalities comprises controlling a ratio of at least two dyes carried by each bead.

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15. The method described in Claim 11, further comprising:  
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encoding the beads with the chemical  
functionalities by entrapping dyes within or  
attaching dyes to the beads; and  
applying the chemical functionalities to the  
beads.

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16. The method described in Claim 11, further comprising  
enabling the chemical functionalities to produce an  
optically active species in the presence of targeted  
analytes to change the optical signature.

17. The method described in Claim 11, further comprising  
changing the optical signature by the presence or  
absence of a fluorescent signal from the beads.

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18. The method described in Claim 11, further comprising  
enabling the chemical functionalities to hybridize.

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19. An analytic chemistry sensor, comprising:  
a bundle of optical fibers;  
a population of beads carrying chemical  
functionalities at a distal end of the fiber  
optic bundle, light from individual bead being  
coupled into separate or groups of separate  
fibers of the bundle for transmission to the  
proximal end of the bundle.

20. The sensor described in Claim 19, wherein each one of the beads is located within separate wells formed at terminal ends of optical fibers of the bundle.
21. The sensor described in Claim 20, wherein the wells are formed by anisotropic etching of the cores of the optical fibers with respect to the cladding.  
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22. The sensor described in Claim 19, further comprising a light source for exciting optically active chemicals bound to the chemical functionalities.
- 10 23. The sensor described in Claim 19, wherein the population of beads includes separate subpopulations, each subpopulation carrying a different chemical functionality and an optically interrogatable code descriptive of the chemical functionality.
- 15 24. The sensor described in Claim 23, further comprising a light source for exciting optically active chemicals bound to the chemical functionalities.
25. The sensor described in Claim 23, wherein code of each subpopulation comprises fluorescent dyes.
- 20 26. The sensor described in Claim 23, further comprising a filter and a frame capturing camera for detecting optical signatures indicative of a status of the chemical functionalities and optical signatures indicative of the encoding of the beads.
- 25 27. A method for constructing and using an analytic chemistry sensor, comprising:  
forming wells at terminal ends of optical fibers within a bundle;

distributing beads carrying chemical functionalities within the wells; and monitoring a status of the chemical functionalities from a proximal end of the bundle.

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28. The method described in Claim 27, wherein forming the wells comprises anisotropically etching of cores of the optical fibers with respect to cladding.
- 10 29. The method described in Claim 27, further comprising forming a population of beads in the wells from separate subpopulations, each subpopulation carrying a different chemical functionality and an optically interrogatable code descriptive of the chemical functionality.
- 15 30. The method described in Claim 29, further comprising randomly distributing the subpopulations within the wells.
31. The method described in Claim 29, further comprising serially adding the subpopulations to the wells.

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